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Matters for consideration or action by the Conference of the Parties: effectiveness evaluation

Report of the ad hoc group of experts on effectiveness evaluation

Note by the secretariat

As referred to in the note by the secretariat on the report on the outline, plan and elements of the effectiveness evaluation framework (UNEP/MC/COP.2/13), the report of the ad hoc group of experts on effectiveness evaluation is set out in the annex to the present note, without formal editing. The report is based on the discussion held at a meeting of effectiveness evaluation experts held in Ottawa from 5 to 9 March 2018 and subsequent discussion undertaken by electronic means. The draft report of the ad hoc group of experts was made available for comment on the website of the Minamata Convention on Mercury from May 2018. The draft report was revised taking into account the comments received and was cleared by the co-chairs of the ad-hoc group of experts before being finalized.

* UNEP/MC/COP.2/1.

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Annex

Report on the work of the ad hoc group of experts on effectiveness evaluation

1. Introduction

The first meeting of the Conference of the Parties decided on a road map, for establishing arrangements for providing the Conference of the Parties with comparable monitoring data, and elements of an effectiveness evaluation framework under article 22 of the Minamata Convention. The arrangements included an ad hoc group of experts, who met from 5 to 9 March 2018 in Ottawa, Canada, and considered issues related to the development of monitoring arrangements and the elements of an effectiveness evaluation framework as set out in the mandate included in the terms of reference for the group, adopted in decision MC-1/9. The discussions at the meeting were structured in line with the mandate, and the results of these discussions are set out in this report. Recommendations are provided at the end of each section.

2. Consideration of Monitoring arrangements

2.a. Outline of the types of data that could be comparable on a global basis, as well as their availability, as well as a draft plan integrating comparable results for future monitoring

In considering comparable data, the group agreed that data on levels of mercury and mercury compounds in air, biota and humans either are available or would be able to be obtained, and would be comparable on a global basis. Other media were considered, such as levels in water and soil. Levels of mercury and mercury compounds in water are collected in relation to water quality issues in a number of countries. These data may be useful in tracking mercury resulting from local activities which release mercury, however may not provide overall trends on a global basis. Levels of mercury in ocean water would be comparable on a global basis, however, there were concerns about the technical feasibility of such sampling. Soil samples may be very useful in assessing the state of contamination of a particular site, but global comparability may not be feasible, given differences in soil types etc. Data on the levels of mercury in sediments are very relevant for the associated levels of mercury in biota; however sampling of sediment was considered not as widespread, nor as easily comparable on a global basis, at this time. The importance of the collection of data from these media for specific purposes was recognized, however they were not proposed for inclusion in global monitoring activities. More detailed information was then developed on the selected media groups (air, water and biota) and is described in a section below. Data considered for the selected media in this section are those which can be compared on a global basis and include a subset of data which may be obtained through monitoring activities conducted at the national level. Further information on data available through existing regional programmes is presented in section 2.b below.

Air

Mercury levels in ambient air have been measured in some locations for a very long period. These data have contributed to the discussion on the global nature of the mercury issue. The current available data is collected by various national and global network owners using different sampling methods. A number of suitable methods are available, and the available sampling techniques considered suitable to obtain globally comparable data were identified and reviewed. As reviewed in 2.b, and 2.c, it was recognized that none of the currently available data had global coverage, but that there are suitable methods to obtain such global data.

The expert group recommended that air concentration data be collected as total gaseous mercury (from both active and passive sampling), and wet deposition data be collected to understand total deposition. It is important that there is agreement on the specified time period over which to report averaged data, as this may be reported monthly, annually or seasonally (noting that 'seasonal' may have different meanings i.e. summer/winter, wet/dry etc.). In addition, the requirement for data completeness also needs to be specified. In considering data obtained at different monitoring sites, the type of monitoring site, and the reason for collecting the data should be elaborated. A number of existing data sets with available comparable data were highlighted, and are presented in more detail in the next section.

The group agreed that there is a significant geographical coverage of ambient air monitoring of mercury, but that there are gaps in certain regions. These geographical gaps should be identified and a plan should be in place to cover them. These include gaps in Africa, Latin America, the Caribbean,

certain parts of Asia and the Pacific and in Russia. These gaps could be covered with a combination of passive sampling as well as some additional active sampling. It was noted that some passive sampling is already producing data, but that further information to ensure global comparability will be needed as some of these techniques are new. In some countries, manual active sampling has been used and has produced reliable data sets. As part of filling the gaps, establishing some sites where combination of established and new methods including, for example, active and passive sampling, as well as wet deposition measurements are carried out (i.e. supersites), would improve data availability and improve confidence in the comparability of different sampling methods. A global ambient mercury monitoring program should be developed to systematically identify future monitoring sites. It is considered necessary that in the initial periods, data collection should be done more frequently (e.g. monthly sampling) to fill in the current regional information gaps. Once there is sufficient information available, the frequency could be adjusted to match other regions. It may be useful to look at lessons learned from Stockholm Convention, in particular the necessary sustainability of the sampling and analysis, to allow proper capacity building in countries lacking such experience.

Other air data which may be comparable and implemented in future plans include atmospheric speciation data (gaseous oxidized mercury and particle bound mercury).

There are a variety of active sampling methods by combination of automated vs. manual gold traps, detection by CVAFS vs. AAS, and several suppliers including Tekran, Lumex, NIC, and PSA. Further technical review of methods may be needed. Passive sampling methods include methods which are currently available as well as those under development, including active carbon (Canadian), titanium dioxide (GMOS) and gold beads (Republic of Korea/Thailand) or gold cores (Radiello tubes, Italy-Denmark).

Human biomonitoring

The general population is primarily exposed to mercury through the diet, i.e. methylmercury in seafood. Assessment of prenatal exposure is recommended because the fetus is most vulnerable to methyl mercury exposure. There are two main biomarkers:

- total mercury in maternal scalp hair (3 cm hair strand from the scalp, to measure exposure during the 3rd trimester)
- Total mercury in cord blood – recent exposure to methyl and elemental mercury

Scalp hair is a preferable biological matrix. It is easily available, a non-invasive method, and there are no specific requirements for transportation and storage.

Cord blood can be alternative matrix to hair. Inclusion of cord blood in a survey provides several additional advantages such as: demonstration of pre-natal exposure to mercury (cord blood analysis characterizes both exposure of a mother and a child to mercury during pregnancy); possibility to get more reliable results and exclude influence of external factors (e.g. external contamination of hair by mercury, permanent hair treatment decreasing mercury in hair); provision of information on exposure to elemental mercury in addition to methylmercury; being an alternative biological matrix to hair in locations where hair sampling is difficult due to cultural, ethical, religious specificities.

Another biomarker, total mercury in urine, is relevant for populations with high exposure to elemental and inorganic mercury, and is not appropriate for assessment of methylmercury exposure. It may be useful for monitoring the impact of control actions taken by Parties on mercury exposure in mining communities, however it has not been included as a biomarker for general human biomonitoring.

There are reliable, although variable, coefficients allowing comparability of results from the mercury measurements in hair and blood/cord blood.

Assessment of total mercury is sufficient for characterizing exposure, unless external exposure to scalp hair needs to be evaluated.

Additional data (epidemiological questionnaire, fish monitoring (for estimating dietary intake), environment contamination data) support interpretation of mercury human biomonitoring results.

The outcomes from the GEF-funded project "Development of a Plan for Global Monitoring of Human Exposure to and Environmental Concentrations of Mercury" indicate that approximately 5 year intervals are feasible for human biomonitoring surveys, considering the aim to identify statistically significant differences as well as the time such studies take to implement (including adaptation of the master protocol to local circumstances, local ethical approval, training of staff etc.). Consumption of fish, marine mammals and other seafood varies with a variety of factors including cultural background, economic status, food preferences, season and others, therefore studies in a particular location need to be conducted in a way to account for seasonal variations and other factors.

Harmonized protocols and standard operating procedures are either close to finalization or are available as follows:

WHO Master Survey Protocol: *Human biomonitoring survey assessment of prenatal exposures to mercury using biomarkers in cord blood, maternal urine and hair* (WHO 2018, in press)

WHO Standard Operating Procedures (SOPs) for:

- Quality Control Programme
- Assessment of mercury in human scalp hair
- Assessment of mercury in cord blood
- Assessment of mercury in urine
- Alternative analysis method – i.e. Determination of total mercury in sediment and biological samples by flow injection analysis and AAS detection
- Monitoring of fish and marine mammals contamination (interpretation for human consumption)

The draft Global Mercury Assessment 2018 has identified currently available data on mercury exposure in national human biomonitoring programmes, longitudinal birth cohort studies and cross-sectional information in specific populations including high exposure groups.

- In national human biomonitoring programmes, some information may be comparable (depending on the ability to disaggregate data by sex and age within the programme). Such studies are only available in a very small number of countries, primarily in the Northern Hemisphere. Such studies are expensive and therefore not feasible for the sole purpose of monitoring global mercury exposure.
- Comparable and high-quality data exists from a number of longitudinal birth cohort studies, including in groups consuming large amounts of seafood, freshwater fish and/or marine mammals. These are available only in a small number of locations, and are not globally representative.
- The aforementioned GEF project has generated comparable data in a small number of additional countries, using the WHO protocol (to be published).

Studies using the WHO protocol for assessment of prenatal exposure to methylmercury are recommended to fill the data gaps in order to obtain a global picture necessary for effectiveness evaluation. The protocol enables collection of comparable data (e.g. hair samples from 250 people per study location recommended). The studies are country-driven. Local ethical (Institutional Review Board) clearance is required and the studies are conducted within the health system, therefore country approval is a given. Each country owns its data and submission of results is voluntary.

Article 17 of the Minamata Convention on Mercury specifies in paragraph 1(d) that each party shall facilitate the exchange of epidemiological information concerning health impacts associated with exposure to mercury and mercury compounds, in close cooperation with the World Health Organization and other relevant organizations, as appropriate. The compilation and exchange of data on mercury levels obtained through human biomonitoring should be undertaken in line with this article of the Convention.

To facilitate the generation of globally representative data and trend information on human biomonitoring, which will be most relevant for effectiveness evaluation, an oversight body should be kept informed of the studies planned and carried out.

Data quality issues are covered by the WHO protocol. Results of the measurements must be analytically comparable between laboratories/different studies. To ensure comparability, each national survey would need to follow the WHO harmonized SOPs for sampling and analytical methods, and develop procedures for quality assurance and quality control that cover the pre-analytical phase. The availability of appropriate reference materials (samples with a certain level of mercury) supports internal quality assurance. External quality assurance should be done through international inter-laboratory comparison investigations (as was done for the WHO/UNEP/GEF Project). Coordination of the studies will contribute to ensure appropriate quality control measures.

The WHO protocol also covers data management, analysis and evaluation issues, including whether this should be done at the national and/or international level. It recommends that participating countries conduct statistical analyses at the national level and submit anonymized data for statistical

analysis to a central database. The aim of a statistical analysis at the international level is to assess associations between biomarker values and predictors such as age, gender, fish consumption habits, etc. (collected via questionnaire) in a pooled dataset. Data communication issues are also addressed in the WHO protocol. These communication issues include communication of the results within the country, to the individuals participating in the study and to policy makers. It should be noted that, in some countries, national guidelines relating to communication of results may already exist.

Biota

Biota samples can provide information for different outcomes. Three types of outcomes, namely human exposure (HE), environmental health (EH), and temporal trends (TT), are identified in relation to biota monitoring

There is enough biotic mercury data available regionally and globally to assess environmental exposure for spatial and temporal trends for many, but not all, ecosystems and biomes of interest. Human exposure to dietary methylmercury can originate from fish, mussels, birds and marine mammals (with fish forming a major contribution, birds forming either a minor or a major component, depending on diets, and marine mammals which can form a major contribution in certain diets). An important aspect in combining monitoring efforts for documentation of convention effectiveness would be to define regional biological species for monitoring, to minimize the effects of species-specific physiological differences. Species that accumulate significant amounts of mercury; pose a potential risk for human health; are widely distributed over specific geographically areas; and that exist in numerous historical studies should be prioritised. Additionally, there is a need to normalize biota by size, age and sex, and these data should be included the data collection process. This is a key issue, particularly with respect to fish. There are numerous methods for doing this, and the choice of method will potentially influence levels/trends. This has potential to prove to be an obstacle in obtaining useful data, and recommendations on the methods should be agreed early in the process. The choice of fish species for sampling should be based on the trophic level, with trophic level 3 or 4 being most appropriate based on literature, FishBase (www.fishbase.org) and/or experimental data.

Experiences from a large freshwater fish mercury database[1] containing more than 50 000 entries from approximately 3000 Fennoscandic lakes revealed a need for also separating lakes with different pollution sources. The database from Fennoscandia revealed that lakes influenced by a historical local pollution source on average had higher fish mercury concentrations than lakes only influenced by long-range atmospherically transported pollution. The groups of lakes also demonstrated different patterns of long-term trends (1965-2015), demonstrating the need for documenting the local pollution sources when evaluating the effectiveness from convention measures.

In order to potentially explain how the temporal trends of fish mercury concentrations change under influence of different drivers, including environmental/climate change in addition to deposition change, a set of minimum target information should be developed. For each location this should include lake (or river, estuary, sea etc.) catchment morphology, pollution deposition patterns, and local pollution history. For each biota species (here exemplified by fish) minimum data must include length, weight, sex, and sexual maturity. Samples (i.e. fish muscle) for determination of total mercury concentrations, should also be analysed for stable isotopes (at least nitrogen and potentially also carbon) for a better understanding of the food web processes. Many of these parameters are lacking from current databases. As an example, inter-annual and intra-annual variability is often much larger than long-term trends, making it difficult to relate temporal trend changes to large environmental drivers (including deposition). The spatial variation within the temporal trend must be considered when investigating convention effectiveness in years to come. To be able to document potential temporal trends changes, one need to lower the within-year variability, by improving the data adjustment, include more lake data and information, and collect data from the same lake over time.

Biota samples via varmint hunting may also be considered as it is collected by other initiatives and available without extra efforts.

In assessing samples, it is recommended to assess muscle tissues for fish and marine mammals. For birds, blood should be used for short term data, muscle or eggs should be used for medium term and feathers can be used for long term results. It is considered to be sufficient to assess total mercury for all tissues (assuming greater than 80 per cent methylmercury mean level) using either wet weight or dry weight. Samples should be georeferenced, with the level of detail varying according to the

[1] The database is presented in an ICP Waters report nr 132/2017 Spatial and temporal trends of mercury in freshwater fish in Fennoscandia (1965-2015). The report is available from the ICP Waters homepage, number 132 in the list: http://www.icp-waters.no/publications/#nivarep

objective of the sampling. Standard operating procedures are available for example through national /regional monitoring programmes, however additional more universal protocols may need to be agreed on for other sampling which is not covered by this process. Inter-tissue conversions are generally feasible to help provide a way to have standardized, and therefore comparable, tissue mercury concentrations.

All issues raised in above sections may need to be appropriately modified, depending on the purpose of use of monitoring data for different outcome indicators.

Table 1. Draft Plan for Outcome Indicators by Biome and Ecosystem Type for Future Monitoring*

Biome	Land (i.e., wetlands)	Freshwater	Saltwater	Comments
Polar	HE – birds EH – birds TT – birds	HE – fish / birds EH – fish / birds TT – fish / birds	HE – fish / marine mammals EH – fish / birds / marine mammals TT – fish / birds / marine mammals	Young fish used for rapid changes and EH, mature fish for long-term changes and HE
Temperate	HE – birds EH – birds TT – birds	HE – fish / birds EH – fish / birds TT – fish / birds	HE – fish / birds EH – fish / birds TT - fish / birds / mussels	Young fish used for rapid changes and EH, mature fish for long-term changes for HE
Tropical	HE – birds EH – birds TT – birds	HE – fish / birds EH – fish / birds TT - fish / birds	HE – fish / birds EH – fish / birds TT - fish / birds	Young fish used for rapid changes and EH, mature fish for long-term changes for HE

* Outcome indicators also vary by objective: HE=Human Exposure, EH=Environmental Health, and TT=Temporal Trends.

The group also worked on an outline of a draft plan (set out in Table 1) that would integrate comparable results for future monitoring

General issues on the draft plan

For all three media components (air, biota and human biomonitoring) discussed in the previous section, there is a need to identify data gaps and determine how they may need to be filled over time. The need for long term efforts and sustainable activities is recognized, and there may be opportunities for synergies with other monitoring programmes where appropriate.

A process for integrating the currently available information as well as newly obtained information needs to be established. Potential needs for formal agreements on institutional arrangements between the Conference of the Parties of the Minamata Convention and existing regional networks are identified to facilitate data sharing and ensure availability of data which has been submitted to such networks.

A formal process for data management and assessment will need to be established, including ensuring that countries are engaged in the submission of their information (either directly or through the existing regional programmes).

A process to ensure that data is made available, through publication and electronic sharing of data for the purposes of the Minamata Convention will need to be established, including the process for developing a global monitoring report. It is considered appropriate to have a working group of experts, comprising six experts per UN region, with at least one expert from each of the air, biota and human monitoring areas. These experts would assist in coordinating input to the global monitoring report from the region, as well as serving in their personal capacity for the preparation of the global monitoring report.

2.b. Review of information on existing monitoring programs

A number of monitoring programs currently exist in different matrices at the global, regional or national level. These programs will provide useful input to the monitoring report for the purposes of the effectiveness evaluation of the Minamata Convention on Mercury.

The United Nations Environment Programme has published a Global Mercury Assessment in 2013, and will publish a new assessment in 2018. The assessment now includes information on emissions to

air, releases to land and water, biota and human exposure. The information has been available for review by all governments prior to publication, and the assessment may provide useful information.

In preparation for the meetings of the seventh session of the intergovernmental negotiating committee and the first meeting of the Conference of the Parties, the secretariat called for the submission of information on monitoring programmes undertaken at the national, regional or global level. Many of the submissions are covered in the above references, however further information can be found at http://mercuryconvention.org/Negotiations/INC7/INC7submissions/tabid/4754/language/en-US/Default.aspx and
http://mercuryconvention.org/Negotiations/submissionsforCOP1/tabid/5535/Default.aspx.

Air

GMOS

The **GMOS** (Global Mercury Observation System) network (www.gmos.eu/sdi) includes over 30 monitoring sites in both Southern and Northern Hemispheres and is the only global network able to provide comparable data on mercury in air and precipitation samples in both hemispheres. It continues to operate many of the sites in coordination with national programs and regional agreements. Monitoring stations are located mostly at background sites in order to intercept major intercontinental and continental air mass transport patterns. GMOS monitoring sites have been classified as "Master" or "Secondary" sites. Master stations are those where Gaseous Elemental Mercury (GEM, i.e. the gas phase mercury in its ground electronic state), Gaseous Oxidized Mercury (GOM, i.e. the oxidized gas phase mercury compounds), Hg associated with suspended particulate matter (PBM2.5) and Hg in precipitation are continuously measured. Secondary stations are those where only GEM and Hg in precipitation are continuously measured. GMOS part of GEO Flagship "Global Observing System for Mercury (**GOS^{4}M**)" (www.gos4m.org) which is aimed to develop a coordinated global network for monitoring mercury in the environment including atmosphere, water, soil and biota. The data gathered in GMOS as well as those catalogued in GOS^{4}M are made available through the GEOSS Platform (www.geoportal.org/community/gos4m). GOS^{4}M is a partnership between the Members of mercury monitoring networks and programmes and collaborating organizations that provide reliable scientific data. The GOS^{4}M is also aimed to support the Minamata Convention including Art. 19 and Art. 22.

Regional programs for monitoring include the following:

EMEP: European Monitoring and Evaluation Programme (EMEP) covers currently includes about 37 sites across 17 countries, and considering all years since 1983, the total number of sites is 64 sites and 23 countries. The main objective of EMEP (www.emep.int) is to provide governments with information of the deposition and concentration of air pollutants, as well as the quantity and significance of the long-range transmission of air pollutants and their fluxes across boundaries. The EMEP observations include measurements of species linked to acidification, eutrophication, photochemical oxidants, heavy metals, persistent organic pollutants, and particulate matter (www.emep.int). Heavy metals entered the agenda of the UNECE - Convention on Long-Range Transboundary Air Pollution (CLRTAP) in the 1980s. At that time, mercury was only of secondary priority, as it was considered that measurements of the relevant chemical forms, and the understanding of chemistry involved, was not mature enough for any regional scale harmonized monitoring to be initiated (EMEP-CCC, 1985). By 1990, the number of sites measuring mercury in air had increased to seven, with sites located in Norway, Sweden, Denmark, Germany and the UK. Mercury was included in the 1st priority list of measurands in the late 1990s, and since then, the number of sites has increased gradually. EMEP observation data are openly available at http://ebas.nilu.no.

APMMN: The Asia Pacific Mercury Monitoring Network (APMMN) (apmmn.org/) is a cooperative effort to systematically monitor wet deposition and atmospheric concentrations of mercury in a network of stations throughout the Asia-Pacific region. The objectives of the network are (1) determine the status and trends in concentrations of ambient mercury species, and wet, dry, and total atmospheric deposition of mercury, (2) develop a robust dataset for regional and global modeling, (3) assist partner countries in developing monitoring and assessment capacity, and (4) share data and monitoring information. The program launched in 2012, through discussion of ca. 30 scientists in the region including the United States, Japan and Korea. Participants identified key monitoring gaps in the region and articulated the need for a coordinated, Asia-wide network to monitor mercury transport and deposition; and this is the basis of the objectives of APMMN. Since launching, the program developed and adopted APMMN SOPs, based on those of the National Atmospheric Deposition Program (NADP), to monitor mercury in rainwater, developed standardized quality assurance, and established three mercury wet deposition pilot sites. New partners continue to join the network, which is expanding the mercury wet deposition monitoring coverage in the region. The program also continues to explore networking atmospheric mercury monitoring systems into a harmonized network,

including continuous atmospheric monitoring and atmospheric mercury monitoring using manual-sampling protocols.

AMAP: The Arctic Monitoring and Assessment Programme (AMAP) (www.amap.no/) is an Arctic Council Working Group that focuses on the preparation of assessments that describe sources, pathways, levels, trends and effects of anthropogenic pollutants in the Arctic environment, including humans. AMAP information is based largely on ongoing national and international monitoring and research activities. AMAP assessments are scientifically independent and subject to international peer review. Priority issues addressed by AMAP include persistent organic pollutants (POPs), heavy metals (particularly mercury), climate change, and ocean acidification. On the basis of its assessment work, AMAP produces policy-relevant recommendations for action that are addressed to the Arctic Council, governments and relevant international bodies; AMAP has been tasked by the Arctic Council to support work ongoing under relevant international conventions. AMAP assessments are freely available from its website: www.amap.no

National programs for environmental mercury monitoring include the following:

Canada

Atmospheric mercury monitoring in Canada began in the early 1990s. Since that time, the number and location of measurement sites has changed and, as of 2017, the current sites for atmospheric mercury monitoring have been consolidated and fall under Environment and Climate Change Canada – Atmospheric Mercury Monitoring or ECCC-AMM network. Canada measures Total Gaseous Mercury (TGM), Mercury in wet deposition and atmospheric speciated mercury (reactive gaseous mercury (RGM), particulate mercury (PHg) and gaseous elemental mercury (GEM)). These data are collected through a group of research programs and follow the same protocols and procedures for data collection and quality control. The data are produced on an open data portal through Environment and Climate Change Canada.

Canada provides atmospheric mercury monitoring data to AMAP through its national Northern Contaminants Program (NCP). Canada has the longest Arctic atmospheric Hg record in the world having measured TGM and atmospheric speciated mercury at Alert, Nunavut since 1995 and 2002, respectively. NCP also monitors TGM in the western region of the Canadian Arctic at Little Fox Lake, Yukon. These data follow all the ECCC-AMM protocols described below.

Kingdom of Denmark

Kingdom of Denmark provides atmospheric mercury monitoring data from Greenland to AMAP through its national program and data is collected at the monitoring Station Villum Research Station, Station Nord, North Greenland. In Greenland, continuous measurements of GEM in the atmosphere have been measured since 1999. Snow samples of total mercury in surface snow have been measured since year 2010. Data is provided to the AMAP thematic data center.

Mercury has been monitored regularly in Greenlandic biota in marine, freshwater and terrestrial species in North, West and East Greenland since the late nineties. Biota data is available on ICES: http://www.ices.dk/marine-data/data-portals/Pages/DOME.aspxor.

Human levels of mercury have been measured in Greenlandic inuits in the blood of mother child cohorts since the late nineties. Mercury is also monitored in several mother child cohorts from the Faroese population and in marine and terrestrial biota. The Faroese and Greenlandic studies have been reported in assessment by the Arctic monitoring and Assessment Programme (AMAP). Kingdom of Denmark is presently the co-lead in the Human Health Assessment Group, AMAP.

Denmark has participated in several programs among others, the former EU program DEMOCOPHES where mercury was monitored in mother child cohorts.

United States

The National Atmospheric Deposition Program's Mercury Deposition Network (MDN) makes long-term measurements of Hg in precipitation (wet deposition) across North America. The MDN began monitoring in 1996. The MDN sites follow standard procedures, and uniform precipitation collectors and rain gauges to make weekly-integrated measurements of THg in a combined precipitation measurement (wet only). Currently, the MDN has 106 active sites. All MDN samples are analysed for THg concentration and invalid samples are identified using standard protocols. Subsamples for some sites are analysed for methyl mercury (MeHg). Valid and invalid results are provided for use by the scientific community. In addition, The NADP's Atmospheric Mercury Network (AMNet) measures atmospheric Hg that contributes to Hg deposition using automated, continuous measurement systems, and standardized methods. Currently, there were 21 AMNet sites,

and data from the AMNet are available on the NADP website (http://nadp.slh.wisc.edu/amnet/default.aspx). AMNet observations have been made since 2009 and are made continuously and qualified and averaged to one-hour (GEM in ng m^{-3}) and two-hour values (GOM, and PBM2.5, in pg m^{-3}). Valid data are released for use by the scientific community, and also released in annual figures of Hg variability for sites meeting certain criteria.

Republic of Korea

National atmospheric mercury monitoring is undertaken as part of the Korean Air Pollution Monitoring Network by the Ministry of Environment since 2014. In the network, as of 2017, there are 12 active monitoring sites for Total Gaseous Mercury (TGM), including 2 sites for atmospheric speciated mercury (GEM, GOM, and PBM2.5) and 5 sites for wet deposition in mercury. Annual TGM data are available in online (www.airkorea.or.kr).

Japan

Japan has been conducting a variety of mercury monitoring in humans and the environment. Environmental monitoring includes monitoring of atmosphere, water, marine environment, and humans. Ministry of the Environment of Japan (MOEJ) has been conducting "Marine Environmental Monitoring Survey" and "Survey of the Exposure to Chemical Compounds in Human" that includes long term mercury monitoring on various environmental media and the human body. Monitoring of Hazardous Air Pollutants has monitored Total Gaseous Mercury concentrations using a gold-trap more than 250 sites throughout the country once a month since 1998. Baseline monitoring of atmospheric Hg species and Hg in wet deposition has been running using continuous measurement systems since 2007 at Cape Hedo, Okinawa. Total mercury monitoring and analysis on seawater and sediments has been studied in "Marine Environmental Monitoring Survey" for nearly 40 years around Japan's exclusive economic zone (EEZ). In addition, total mercury analysis on marine products has been conducted for the last 20 years. Under "Survey of the Exposure to Chemical Compounds in Human", total mercury in blood, and total and methyl mercury in diet of the general population has been conducted for the last 6 years. Japan has also conducted capacity development on mercury monitoring introducing gold amalgamation trap – atomic absorption spectrometry (Official monitoring method in Japan) for the participants from more than 20 countries through several capacity building programs. Japan also will work to establish atmospheric mercury monitoring program in Asia-Pacific region, with close cooperation with APMMN and other relevant countries.

Norway

The Norwegian Environment Agency monitors hazardous chemicals including mercury in air and precipitation, lakes, fjords, marine areas and in terrestrial environment. The following monitoring programs include mercury; contaminants in coastal waters (Hg in marine biota); riverine inputs and direct discharges (Hg in river water); contaminants in urban fjords (Hg in biota, sediment and water); contaminants in terrestrial and urban environment (Hg in biota); contaminants in lakes (Hg in biota); monitoring of long range transported contaminants (Hg in air, moss and precipitation). Monitoring is mainly conducted in organisms such as cod, blue mussels, trout, seabirds, zooplankton, shrimps, bird of prey, earthworms and foxes. Monitoring is both close to hotspot sources like industry and cities and in pristine areas like air monitoring on Svalbard. A majority of our monitoring are time trend monitoring providing national trends for mercury dating back to 1984. The national monitoring is founded in regional programs such as EMEP, AMAP, OSPAR and EU Water Framework Directive.

Norway also provides facilities for the ICP Waters Programme Centre, where the Norwegian Environment Agency provides financial support. The main aim of ICP Waters is to assess, on a regional basis, the degree and geographical extent of the impact of atmospheric pollution on surface waters, and in 2017 the Centre published a report on mercury concentrations in fish. The report presents an extensive database of more than 50 000 measurements of mercury in fish from approximately 3000 lakes throughout Fennoscandia, sampled between 1965 and 2015. The report discusses the usefulness of such databases for assessments of impacts of environmental policy on mercury in freshwater fish, and is available from the ICP Waters web page (http://www.icp-waters.no/).

Human Biomonitoring

Some of the regional and national programmes summarized above include human biomonitoring. Other human biomonitoring progammes include the following:

United States: National Biomonitoring Promgram

https://www.cdc.gov/biomonitoring/Mercury_BiomonitoringSummary.html

Canada: Human Biomonitoring of Environmental Chemicals

https://www.canada.ca/en/health-canada/services/environmental-workplace-health/environmental-contaminants/human-biomonitoring-environmental-chemicals.html

Biota

For biota, the following table provides information on ecological exposure to mercury, with the biota monitoring contributing information on human exposure through the diet. Table 2. Existing sources

Ecological Exposure –

Entity	Country	Interval: Sampling(S) Reporting(R)	Taxa	How the data are available? (All are available)
AMAP (national monitoring countries are listed)	Canada, Russia, U.S., Kingdom of Denmark, Finland, Sweden, Norway, Iceland	Varies (S) Variable (R)	Fish, birds, marine mammals (Human monitoring also undertaken)	AMAP
Water Framework Directive	EU	3 yrs. (S) 6 yrs. (R)	Fish	EU
Ospar/HELCOM Convention	EU	Annually(S) Annually(R)	Mussels	EU
National Monitoring Programs	Many	varies	Fish, bird, marine mammals	Party – Regional Expert(S)
National Environmental Specimen Banks	Many	annually	Fish, mussels, bird, marine mammals, terrestrial mammals, soil, suspended particulate matter, tree samples, mosses, lichens, human samples	Party – Regional Expert(S)
Regulatory Monitoring Programs	Many	varies	Fish, bird, marine mammals	Party – Regional Expert(S)
University Projects	Many	varies	Fish, bird, marine mammals	Party – Regional Expert(S)

Human Exposure

Entity	Taxa	How the data are available
WHO GEMS/FOOD (CODEX tool for collecting monitoring data)	Biota intended for human consumption, including fish and other seafood	WHO – submitted by authorized national institutions including National Food Regulatory Programs.
National/Regional Food Regulatory Programs	Fish	Party – Regional Expert

Other sources for monitoring include the following:

Data is available through the **Codex Alimentarius Commissioa** on mercury levels in certain fish species. They are in the process of establishing Maximum Levels for methylmercury in certain additional fish species as well as an associated sampling plan, which outlines requirements for sample preparation and analysis. This is expected to increase the data available.

ICP (International Cooperative Programme) Vegetation (Atmospheric heavy metal deposition in Europe is estimated based on moss analysis. The programme started in 1991and is performed at 5 year intervals (http://icpvegetation.ceh.ac.uk/research/heavy_metals.html).)

Environmental specimen banks archiving tree leaves, lichens and mosses from various regions and often have Hg temporal trend data available.

2.c. Assessment of to what extent the information reviewed under (b) meets the needs for monitoring set out in paragraph 2 of Article 22 of the Minamata Convention on Mercury, and outline of options to enhance comparability and completeness of the information

Conclusion: The data available through existing monitoring programs partially meets the needs for monitoring under Article 22 of the Minamata Convention on Mercury, however a number of limitations and gaps were identified.

Air

It was noted that currently there is not global coverage of information on air levels of mercury, with large gaps identified in Africa, Latin America and some parts of Asia and the Pacific, as well as gaps in the Caribbean. There are also uncertainties in the available data particularly in relation to mercury fluxes to air from ocean surfaces and climate change impacts such as melting ice, permafrost and potential increases in run-off.

In order to enhance the comparability and completeness of the monitoring information, the group recommended that the data collected be available in a central location that can provide access to regional and national network information. Thus, if the data is available on national/regional program databases, links to these data can be provided to a central database). Should the data not be available in databases, it is recommended that support be provided to house the data on a central database, where appropriate. This could be undertaken through an agreement between countries or regional programs and the organized central database.

It is also recommended that all data should be catalogued by providing metadata following ISO 19115 Standards, which minimal content should be established by the COP with support of experts.

Regional programs already have the (data) infrastructure and it will be cost-effective to use them (when available.) One example where they have used the term «federation» of regional programs is the WMO-Global Atmosphere Watch, see https://library.wmo.int/opac/doc_num.php?explnum_id=3395

If primary data is in official databases in regional networks one need to be able to search on a global scale. Three examples of where data is stored one place but access is given through searchable portals are: http://gmos.eu/sdi, http://actris.nilu.no and https://gawsis.meteoswiss.ch/GAWSIS//index.html#/search/station

Should the data not be available on a database, the country can deliver the data (in a manner that suits the country) to the global monitoring group, however the data should be accompanied with proper metadata to maintain data comparability.

Human

For human biomonitoring, as explained above, the available data relating to levels of mercury in human populations are insufficient.

Biota

For biota, it has been recognized that there is a large amount of published data available, as well as unpublished data collected for commercial and governmental purposes. However, it is not clear, to what extent published and other data reflect background information on mercury levels, or whether existing data emphasizes areas where high mercury concentrations are expected. As previously described, the large Fennoscandian assessment[2] of levels in freshwater fish, during 1965-2015, revealed that mercury levels in fish from lakes with local mercury sources were responding to regulation and management. Further evaluation work on existing data is required to gather all currently available globally representative biotic mercury data, to assess what data are relevant, comparable and able to be harmonized. This process will allow a clearer identification of data gaps, which may be geographic or taxonomic.

[2] The assessment included samples from Norway, Sweden, Finland and Russia

2.d. Consideration of cost-effectiveness, practicality, feasibility and sustainability, global coverage, and regional capabilities in identifying opportunities for future enhancements to monitoring

The available sampling techniques considered suitable to obtain globally comparable data were reviewed, and several identified methodologies were found to be appropriate from the viewpoint of cost-effectiveness, practicality, feasibility and sustainability, although thorough analysis of cost effectiveness was not conducted. It was recognized that there was analytical capacity already available in all regions. It was recognized that none of the currently available data had global coverage, but that there were suitable methods identified to obtain such global coverage. Regional capabilities in terms of data assessment had been evaluated through the GEF-funded project "Development of a Plan for Global Monitoring of Human Exposure to and Environmental Concentrations of Mercury", identifying suitable laboratory capacity in all regions. Regional capabilities for sampling were not currently available, however expansion of current monitoring to fill the gaps was considered feasible.

Air

For air, many current monitoring networks currently use active atmospheric mercury sampling and funding for these networks is hoped to continue, although as controls on mercury increase, some governments may identify this as a lower priority. While continuous/automated active sampling provides excellent, comparable, highly temporal data, it is relatively expensive, requires capacity and continuous, reliable power. Continuous/automated active sampling primarily requires dedicated personnel to operate the instrumentation at a given site. There are less expensive active sampling methods using traps available and the analysis can be made at a central laboratory. Both of these methods are feasible at locations with power and can be intercompared on a global level. Sustainability of this monitoring will require agreements within the monitoring sites/stations with the country and it is also preferable that this type of monitoring be undertaken where other ancillary data is collected. In areas where continuous/automated active sampling is not represented or possible, passive or manual active sampling can be made possible. The choice and deployment of future sites, as well as the choice of analytical facilities, can be based on decisions made from the passive sampling projects and / or other pilot projects (intended to give a future outlook for where active monitoring could be undertaken). However, a global mercury monitoring plan can be developed to identify future sites and incorporate the existing monitoring sites. This long--term plan will assist in estimating the necessary financial resources required to achieve a global ambient air mercury monitoring coverage.

Initial deployment of some passive or manual active samplers can be through existing programs (e.g. adding passive mercury sampler to the Global Atmospheric Passive Sampling network[3]) to ascertain feasibility and initiate capacity in areas of monitoring gaps. Long term goals will be to develop national/regional capacity for sustainability of the monitoring program (perhaps using existing BRS regional centres, and other regional arrangements and networks). These activities can be linked to the capacity building activities under the Convention, as well as the obligations under Article 19. There is an expectation that there will be some long-term commitment of Parties for continued funding to ensure sustainability of monitoring programs.

For continuous/automated active sampling, programs that currently operate this type of monitoring can continue to do so and develop standard operating procedures that ensure comparability across all regions. This has been undertaken in many areas and it is recommended that intercomparison studies be made to ensure the comparability across different monitoring methods and locations. Should a Party wish to engage in continuous/automated active mercury air monitoring and they have funding in place, there are many experts around the world who would be able to help with developing a program (e.g. the fate and transport area of the Global Mercury Partnership).

For wet deposition information, countries and/or regional programs have organized their samplers and analysis programs and use the existing capacity for the analysis of the data.

[3] https://www.canada.ca/en/environment-climate-change/services/air-pollution/monitoring-networks-data/global-atmospheric-passive-sampling.html

Biota

For biota, in considering future monitoring, it is thought to be important to use a structure that is based on the overarching objectives that integrates outcome indicators by biome and ecosystem type (see Table 1). This will require gathering biotic mercury monitoring data using consistent SOPs. Following this, future enhancements for monitoring activities will be used to fill gaps, with potential to emphasize major mercury sources such as artisanal and small-scale gold mining. The time intervals of monitoring will depend on the overarching objective, biome, ecosystem type, and the outcome indicator. Initially annual biomonitoring will assist in establishing a solid base of information. Additional data sources will include any additional fish mercury data as gathered through the Codex Alimentarius Commission's risk management process (Maximum Level development for retail fish species).

Human

For human biomonitoring, sampling of scalp hair and cord blood is considered feasible and practical, including in terms of cost effectiveness. It is anticipated that sampling programmes will be designed which meet national priorities, and that the data thus collected will be provided.

Conclusion: For all types of monitoring discussed in this report, the availability of sampling and analytical methods considered to be cost-effective, practical, feasible and sustainable were identified, although further discussion such as monitoring cost may be needed. In any given media, it was concluded that there was not global coverage in regard to sampling sites at this time, however there is potential to expand to meet these needs while keeping costs low, ideas practical, feasible and sustainable.

It was noted that Parties should give consent to the monitoring data used for the effectiveness evaluation as representation of the country. The possibility of regional centres established under the Basel, Stockholm and Rotterdam Conventions coordinating some activities, as needed, was discussed. Nevertheless, a need for a specific expertise in data management was outlined and there are options available to provide electronic tools to regions/programs who do not have such tools to store and visualize the collected information.

2.e. Identification of available modelling capabilities to assess changes in global mercury levels within and across different media

Air

Atmospheric mercury modelling is a mature field of research. Several atmospheric mercury models have been created including GEOS-Chem, GLEMOC, ECHMERIT, CMAQ-Hg, WRF/Chem-Hg and GEM-MACH-Hg. Several intercomparisons of the models have been undertaken and are well documented. Modelling will contribute to the evaluation of the effectiveness of the Convention by assessing whether the levels of mercury are increasing or decreasing in the atmosphere as per changes in the emissions of mercury. They will also enable the definition of source-receptor relationships and long-range transport of mercury through the atmosphere. As well, using the data collected through monitoring these models will provide regional and global predictive capabilities of mercury impacting the environment. Also, the group identified the need for developing inter-compartment modelling to assess temporal changes in different media in response to the changes in emission.

This is a lesson that is well-known from efforts in monitoring, reporting, and verification of other trace species in the atmosphere. One technique that is used to derive emissions estimates from atmospheric concentrations is inverse modeling, which runs models "backwards" to derive emission estimates from observed atmospheric concentrations. The type of results that can be gained from inverse modeling approaches can have a substantial impact on policy and effectiveness evaluation. One recent example comes from the Montreal Protocol, where recent research by Montzka et al. (2018) using inverse modeling identified a previously unknown source of CFC-11 production in contravention of Montreal Protocol requirements. Similar analyses, driven by the scientific community, could be useful for evaluating the progress of the Minamata Convention in the future. However, at present, the intercomparability of mercury measurements do not meet the standard required to conduct similar analyses to those done for chlorofluorocarbons. Our recent effort to conduct a similar analysis for mercury emissions (Song et al., 2015) revealed that measurement intercomparison error was the greatest limitation to quantifying sources. The Minamata Convention would be better informed not only by more atmospheric mercury measurements, but also by more accurate and comparable measurements.

Biota

For biota, models are used to make data comparable and can also be used to consider confounding variables such as climate change. The following models are needed and are available or can be made available:

1. creating data comparability, e.g. taxa tissue conversions and taxa size conversions
2. Linking environmental input of mercury and levels in biota
3. Identifying global biological Hg hotspots
4. Spatial and temporal trends

Human

For human biomonitoring, there are models for the impact of dietary, environmental and occupational exposure on mercury levels in humans.

2.f. Identification of sources of data that can be used for establishing a baseline

Currently, there is not a formal process under the convention to establish a baseline. The monitoring plan (mentioned in a) above) considers how to address gaps and organize future monitoring including elements of organizational arrangements.

We acknowledge that mercury has one of the largest available collective data sets of recognized environmental contaminants, while acknowledging that data gaps remain. It is challenging to determine a single baseline for all media considered in this Convention.

Mercury data from all media is available from varying times and from various sources. Data prior to entry into force of the Convention may be useful in particular to consider trends in levels of mercury and mercury compounds observed in biotic media and vulnerable populations. Currently there is not a formal process under the convention to establish a baseline. The baseline can be considered as the current state of knowledge. The group did not carry out an evaluation of using the Global Mercury Assessment Report, or data from national and regional monitoring programmes, as a baseline.

2.g. Identification of how monitoring activities may contribute to the development of the effectiveness evaluation framework

Air monitoring

Total gaseous mercury primarily consists of elemental mercury that has a long atmospheric lifetime which makes mercury a global issue because it can travel from source regions to areas far away from those emissions. Monitoring mercury in the atmosphere can provide information on whether levels of mercury in the atmosphere are changing (trends in mercury levels), what the spatial concentration differences are around the world (the presence of mercury in the atmosphere and if the presence has changed) and how mercury is transported from source regions to areas of deposition (the movement of mercury within and out of the atmosphere). Further, mercury is deposited to the environment from the atmosphere through deposition processes. Monitoring the deposition of mercury from the atmosphere will provide information on the trends and levels of mercury entering the ecosystems.

Mercury levels in the atmosphere is directly linked to the emissions from the anthropogenic sources identified by the convention. The atmospheric monitoring activities will contribute to the evaluation of the effectiveness of the Convention by determining whether the levels of mercury are increasing or decreasing in the atmosphere as per changes in the emissions of mercury and enable the modelling results to define source-receptor relationships. Also, this data will contribute to the predictive capabilities of regional and global models of mercury impacting the environment, which may also be affected by other atmospheric chemistry issues. To assist in determining trends of mercury levels, a minimum requirement will be annually averaged data, and, where possible, monthly and/or seasonally averaged data. Periodic data and quality control procedures intercomparisons of the various methods will be required to ensure comparability on a global scale. While total gaseous mercury (both active and passive) and deposition of mercury (wet, dry and/or bulk) are needed, other data may be provided on a voluntary basis, including but not limited to speciated atmospheric mercury, isotopic atmospheric data and ancillary data.

Human biomonitoring

Human biomonitoring has the following advantage in contributing to the effectiveness evaluation of the Convention.

- Provides information on exposure to mercury from all types of sources
- Integrates the results of the different types of risk reduction measures
- Can demonstrate temporal trends during shorter period of time, compared, e.g. to biota monitoring
- Biota monitoring on its own currently has limitations for estimating human exposure, because of variability in amount and species consumed, variability of methylmercury concentration within a species and limited knowledge of consumers regarding consumed species.
- Provides information on geographical distribution enabling identification of areas and population groups requiring urgent support in terms of risk reduction measures
- Allows gathering new information on exposure to mercury on global and regional scale
- Provides scientific basis and empowers policy-makers and others to implement risk-reduction measures
- Mercury human biomonitoring has long history and solid scientific basis

The WHO/UNEP/GEF Global Monitoring Project has demonstrated that wide use of mercury human biomonitoring is feasible, in particular:

- WHO harmonized methodology for assessment of pre-natal exposure to mercury is available and has been applied successfully in pilot surveys including in a number of developing countries.

Relevant capacities are available in many countries and can be created in a short period in other countries

Biota monitoring

Biota monitoring has the following advantage in contributing to the effectiveness evaluation of the Convention.

- Biota monitoring can provide standardized and comparable data at regional and global levels;
- Biota monitoring can track changes of environmental mercury levels at regional and global levels to determine protection of human health (e.g., vulnerable populations) and the environment;
- Biota monitoring can provide robust and strong scientific and technical information for cost effective and timely evaluation;
- Biota monitoring data can be regularly reported to provide assistance for the COP to evaluate the effectiveness of changes related to Articles 7, 8, 9, and 16 pursuant of Article 21.

Information obtained through monitoring activities undertaken at the global level (air, biota and human) may provide useful contributions to the evaluation of the effectiveness of the Convention, particularly in relation to Article 1 (Objective), Article 7 (Artisanal and small-scale gold mining), Article 8 (emissions), Article 9 (releases), Article 12 (Contaminated sites), Article 16 (Health issues), Article 18 (Public information, awareness and education) and Article 19 (Research developing and monitoring).

Table 3. Possible contribution of monitoring data to the effectiveness evaluation of the Minamata Convention

Article	Description of how global monitoring data (air, human, biota) can contribute to evaluation of the effectiveness of the Convention
Article 1	• Level of mercury in air, human and biota • Attribution of levels of Hg in environment and human from anthropogenic emissions and releases estimated by modelling information
Article 7 - ASGM	• Mercury levels in humans (note that for miners, urine mercury may be appropriate) • Mercury levels in fish and other biota downstream of ASGM activities • Mercury levels in air
Article 8 - Emissions	• Mercury levels in ambient air • Mercury levels in biota to consider local impacts and long-range transport
Article 9 - releases	• Mercury levels in fish and other biota and humans
Article 12	• Mercury levels in air, human and biota
Article 16	• Mercury levels in humans (tracks success in protecting vulnerable populations)
Article 18	• Number of parties that have public information on mercury levels in air, humans and biota
Article 19	• Number of parties that cooperate to develop and improve information available for inclusion in the global monitoring report (including through existing data sources

Recommendations from the expert group in relation to monitoring

Outline of the types of data that could be comparable on a global basis, as well as their availability, as well as a draft plan integrating comparable results for future monitoring

The Conference of the Parties should:

- Establish relationships through the secretariat with bodies that manage existing information;
- Request experts to develop of terms of reference for monitoring arrangements and for implementation of the proposed plan;
- Make a recommendation to the Global Environment Facility[4] on the need for support in the collection of essential data and facilitate sustainable input of monitoring information for effectiveness evaluation

Review of information on existing monitoring programs

The Conference of the Parties should request countries and organization to continue to provide further information on their monitoring programs to feed into discussions at COP3

Assess to what extent the information reviewed under (b) meets the needs for monitoring set out in paragraph 2 of article 22 of the Minamata Convention on Mercury, and on that basis outline options to enhance the comparability and completeness of the information reviewed

The Conference of the Parties should develop a global monitoring plan that includes recommendations with regard to the gaps in available information which should be addressed to fully meet the information needed described in paragraph 2 of article 22.

Consideration of cost-effectiveness, practicality, feasibility and sustainability, global coverage, and regional capabilities in identifying opportunities for future enhancements to monitoring

The group concluded that for the requirements of article 22 of the Convention regarding monitoring data to be met, information should be gathered on levels of mercury in air, biota and humans. Methods which are cost effective, practical, feasible and sustainable are available for all types of monitoring. For air, it is recommended that a combination of air sampling (both active and passive) and wet deposition where feasible be undertaken. For human biomonitoring, hair or cord blood meet all the criteria for inclusion in a global monitoring programme. For biota, the sampling methods might vary depending on the biome and objective, however sampling meeting all the considerations is possible. It was noted that while global coverage of monitoring did not exist at present, the draft plan included recommendations on how to address the existing gaps in coverage. Technologies, analytical capacity and expertise are available to establish global monitoring. The group considered that steady progress could be achieved towards monitoring at the global level as additional programmes were established.

Identification of available modelling capabilities to assess changes in global mercury levels within and across different media

The Conference of the Parties should:

- Encourage Parties to endeavour to cooperate in developing and improving research to include modelling and to validate models, including addressing gaps in modeling such as those related to artisanal and small-scale gold mining (ASGM)
- Request organizations to work on the development, validation and further use of models, including intercompartmental modelling (such as on biota, air and human, or air-water fluxes)
- Ensure the use of modelling to inform the development of the monitoring plan, as well as any future adjustment of the plan, and to develop information for the effectiveness evaluation

Identification of sources of data that could be used for establishing a baseline

The Conference of the Parties should consider making arrangements for a formal process to establish the collection, management and publication of mercury data under the Minamata Convention for the purpose of facilitating effectiveness evaluation, and the need to establish a baseline for that process.

[4] Note that GEF appeared to be more relevant for funding that the Specific International Programme, although it is possible that an individual country may identify monitoring activities which are a strong national priority with arguments as to how the monitoring activities support sustainable implementation of the obligations under its Convention.

Available sources of information, including the Global Mercury Assessment, should be considered in making such arrangements.

Identification of how monitoring activities might contribute to the development of the effectiveness evaluation framework

Recommendations on how information from monitoring, together with appropriate assessment of causality, might contribute to the evaluation of certain articles include:

Article	*Description of how global monitoring data (air, human, biota) could contribute to evaluation of the effectiveness of the Convention.*
Article 1 - Objectives	• Level of mercury in air, human and biota • Attribution of levels of mercury in environment and human from anthropogenic emissions and releases estimated by modelling information
Article 7 - ASGM	• Mercury levels in humans • Mercury levels in fish and other biota downstream of ASGM activities • Mercury levels in ambient air
Article 8 - Emissions	• Mercury levels in ambient air • Mercury levels in biota for the consideration of local impacts and long-range transport
Article 9 - Releases	• Mercury levels in fish and other biota and humans
Article 12 – Contaminated sites	• Mercury levels in air, human and biota
Article 16 – Public information, awareness and education	• Mercury levels in humans (tracks success in protecting vulnerable populations)
Article 18 – Research, development and monitoring	• Number of parties that have public information on mercury levels in air, humans and biota
Article 19	• Number of parties that cooperate to develop and improve information available for inclusion in the global monitoring report (including through existing data sources

3. Consideration of Effectiveness Evaluation Framework

3,a. Steps required to undertake effectiveness evaluation

The ad-hoc group of experts reviewed the process of the effectiveness evaluation of the Stockholm Convention as an example to learn from, with a view to identifying methodological approaches applicable to the Minamata Convention. To the knowledge of the group, the Stockholm Convention was the only multilateral environmental agreement that has explicit provision on the evaluation of the effectiveness of the convention.

The scope of the effectiveness evaluation needs to be established. The key question for the effectiveness evaluation is to what extent the Minamata Convention is functioning toward its overall objectives - to protect the human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds.

Specific questions should be developed for measures stipulated in individual articles, as well as questions to be addressed using monitoring data.

The effectiveness evaluation under Article 22 is at the global level. In addition to national reporting, international reports and other information gathered at a global level, information at local, national and regional levels can also inform the evaluation at the global level.

Stages for conducting effectiveness evaluation is discussed under Section 3 "Process flow for effectiveness evaluation".

3.b. Potential approaches to the development of performance indicators

Indicators should be developed for evaluating the effectiveness of measures stipulated in individual articles.

An overall indicator that takes into account monitoring information and the analysis of article-by-article indicators should also be developed.

Articles can be grouped into the following:

- Control measures
- Information and support measures
- Impact and evaluation measures

Indicators for individual articles should be based on an article-by-article review of information sources, data limitations and baseline.

Process indicators and outcome indicators should be distinguished. Process indicators describe the extent to which measures are taken in relation to the articles of the Convention. Outcome indicators may relate to pressure (e.g. mercury emission to the environment and in humans), state (e.g. levels of mercury in the environment), and impact (e.g. human exposure and potential health outcomes)

The number of indicators should be limited, although completeness of the evaluation should also be considered.

Other considerations on indicators include the following:

- Qualitative vs quantitative information
- Obligatory and voluntary provisions
- Availability of information from parties and non-parties

Based on these considerations, the ad-hoc group of experts developed an initial article-by-article table of potential indicators (Table 4). The table currently does not contain outcome indicators using monitoring data. In considering how information from monitoring can be used as indicators of effectiveness evaluation, it was made clear that:

- implementation of the control measures of the Convention is expected to lead to reductions in supply, use, emissions and releases,
- determining causality between such changes and monitoring results is extremely complex,
- this complexity is expected to increase due to confounding factors that will affect both natural emissions/releases of mercury (e.g. permafrost) and methylation rate,

- another dominating confounding factor is the influence of mercury emitted and released to the environment in the past (legacy mercury),
- should one be able to prove causality, significant time lags are expected e.g. between emission changes and biota levels.

A three-step approach for using monitoring information was proposed as follows:

- assess effectiveness of individual articles based on national reporting and other available information
- undertake an analytical assessment of the whole set of article-by article indicators
- integrate monitoring information as well as appraise whether changes in monitoring data can be linked to effectiveness of the Convention or have been determined by other factors.

One example of integration of monitoring data would be to look at emission inventory data for article 8 (emission) and try to understand if emissions are reducing and how this relates to monitoring data, including mercury in air and biota.

Further discussion is needed to determine whether and how indicators can be drawn from monitoring data.

Table 4. Potential indicators for individual articles of the Convention

Article	Potential indicators	Potential source of information	Discussion
Overall indicator/ Article 1	*Outcome indicator* • Outcome of analytical assessment of the whole set of article-by-article indicators • Further indicators will be considered		Further clarification is needed on how the "whole set of indicators" can be assessed.
Article 3	*Process indicator* • Total number of primary Hg mines. *Outcome indicator* • Total amount of Hg mined from primary mercury mines.	• **Article 21 report.** • UNEP report on supply and trade. • Project reports.	• Data on non-parties are important
	Process indicator • Number of parties that have developed an inventory of stocks and sources of supply.	• **Article 21 report.**	
	Process indicator • Number of parties that have excess Hg from Chlor Alkali. • Number of parties that have taken measures that such mercury is subject to final disposal.	• **Article 21 report.** • Report to other relevant chemicals and waste MEAs	• Also see indicators on trade and waste.
	Outcome indicator • Amount of Hg traded (broken down for specific purposes) *Process indicator* • Number of parties trading in mercury	• **Collected PIC forms** • Article 21 report. • UN trade data • ASGM NAP • UNEP supply and trade report.	• Can compare the amount of legally traded Hg with other data e.g. Hg use in ASGM. – shed light on illegal trade and disposal. – link with other articles.

Article	Potential indicators	Potential source of information	Discussion
Article 4	*Process indicator* • Number of exemptions per product categories.	• **Article 21 report.** • **Register of exemptions** • MIAs may provide information. • Voluntary NIP. • Voluntary information from industry (manufacturers, partnership, etc.)	• May collect information on trade and manufacturing from other sources. • Percentage of parties that have implemented measures may provide information. • Consider an indicator related to market supply of Hg added products
Article 5	*Process indicator* • Number of parties having Annex B processes • Number of parties with exemptions for Annex B Part 1 processes *Outcome indicator* • Amount of Hg used in each of Annex B processes.	• **Article 21 report.** • **Register of exemptions** • Voluntary information from industry • Global Mercury Partnership and MIAs may provide Information	• Consider indicator about measures taken to address emissions and releases of mercury or mercury compounds from the facilities (e.g. reducing Hg in vinyl chloride monomer production)
Article 6	• No indicators. See Art 4 and 5		
Article 7	*Process indicator* • Number of parties declaring more than insignificant ASGM. • Number of parties that have submitted NAP. • Number of parties that have developed health sector strategy. • (Number of ASGM workers covered by projects) *Outcome indicator* • Total amount of Hg used in ASGM.	• **Article 21 report.** • **Notifications** • **Submitted NAPs** • Information from ILO • Info from GEF, national and other projects	• NAP provides baseline estimates and reduction targets in NAPs. Reduction to be reported after NAPs. • Consider indicators using health strategies in NAPs. • Can we put anything on emission? – Hg use serve as a good indicator.
Article 8	*Outcome indicator* • Total amount of Hg emitted from each of point source categories in Annex D. *Process indicator* • Number of countries that have applied BAT/BEP for new sources. • Number of parties that have control measures for existing sources (per each of the measures set out in Article 8 para 5).	• **Emission inventory under Article 8.** • **Article 21 report.** • MIAs • GMA and similar relevant reports	• Self evaluation of effectiveness of measures is required in Art 8 para 11. • Scientific literature may also be reviewed for information
Article 9	*Process indicator* • Number of parties that have identified relevant sources. Number of parties that have established inventory of releases from relevant sources. *Outcome indicator* • Total amount of Hg releases in the inventory.	• **Article 21 report.** • **Release inventory under Article 9.**	• There can be indicators on measures taken on relevant sources. • Self evaluation of effectiveness of measures is required in Art 9 para 8. • Scientific literature may also be reviewed for information • Mercury levels in biota may capture the impact of mercury releases • Need revisiting when COP agrees on the release sources

Article	Potential indicators	Potential source of information	Discussion
Article 10	*Process indicator* • Number of parties that have taken measures to ensure sound interim storage. *Outcome indicator* • Amount of Hg stored as identified in the inventory of stocks. (ref Art 3)	• **Article 21 report.**	• Consider number of parties that have cooperated on sound interim storage. (Art 10 para 4) • Consider how to capture information on stocks of less than 50 metric tonnes
Article 11	*Process indicator* • Number of parties that have measures in place to manage mercury waste in an environmentally sound manner. • Number of facilities for final disposal of mercury/mercury compound waste. *Outcome indicator* • Amount of mercury/mercury compound waste subjected to final disposal.	• **Article 21 report.** • Basel convention report	• Threshold for definition of mercury waste still under discussion. • Can we measure how much Hg waste is managed in an environmentally sound manner? • Consider an indicator on the amount of recovery of mercury from mercury waste (may be available in reporting into on Art 3 source of supply)
Article 12	*Process indicator* • Number of parties that have developed strategies for identifying and assessing sites contaminated by mercury or mercury compounds. • (Number of parties that have developed the inventory of contaminated sites.)	• **Article 21 report.** • MIAs • GMA • Global monitoring report	• Consider further information source for the identification of contaminated sites?
Article 13	*Process indicator* • Number of parties providing financial resources. • Amount of GEF resources provided. • Number of recipient parties of GEF resources. • Amount of SIP resources provided. • Amount of bilateral support provided • Number of recipient parties of SIP resources. • Number of parties that mobilized national resources for implementing the Convention	• **Article 21 report.** • **Report from GEF** • **Report from SIP**	• Where monitoring is collected as part of projects it may deliver information on the effectiveness of the project
Article 14	*Process indicator* • Number of parties providing technical assistance • Number of parties requesting technical assistance • Number of parties receiving technical assistance • Number of parties promoting or facilitating technology transfer	• **Article 21 report.**	• Where monitoring is collected as part of projects it may deliver information on the effectiveness of the project
Article 16	*Process indicator* • Number of parties that have taken measures to provide information to the public on exposure to mercury in accordance with paragraph 1 of article 16. • Number of parties that have taken measures to protect human health in accordance with article 16.	• **Article 21 report.** • Info from WHO and ILO, including potential surveys through INFOSAN • Global monitoring report (note particular reference of AMAP)	• Synergies with ASGM indicator.

Article	Potential indicators	Potential source of information	Discussion
Article 17	*Process indicator* • Number of parties with designated national focal points • Number of parties that have established information exchange mechanisms • Number of parties and intergovernmental and non-governmental organizations that have submitted information	• **Information submitted under Article 17** • **Article 21 report**	
Article 18	*Process indicator* • Number of parties that have taken measures to implement article 18 • Average number of measures under paragraph 1 of Article 18 that are being implemented by parties • Number of parties that have public information on mercury levels in air, humans and biota • Number of parties undertaking risk communication relating to mercury consumption	• Global monitoring report (report of national information and regional programmes) • MIA reports	
Article 19	*Process indicator* • Number of parties that have undertaken research, development and monitoring in accordance with paragraph 1 of article 19 • *Number of parties that cooperate to develop and improve information available for inclusion in the global monitoring report (including through existing data sources)*	• Global monitoring report	
Article 21	*Process indicator* • Proportion of parties reporting on time • Proportion of parties indicating that information is not available for specific questions		• Changes in reporting levels between cycles? • How can we capture the reporting under other articles?
Article 22	*Process indicator* • Evidence of implementation of recommendations from effectiveness evaluation through decisions and actions of the Conference of the Parties		

3.c. Process flow for effectiveness evaluation

The following two-stage process is proposed.

➢Stage 1 Information collection and compilation

- Article 21 reporting – secretariat to compile as a part of reporting cycle, including a set of descriptive statistics
- Other submission to the secretariat (PIC, NAPs, emission inventory, exemption, voluntary NIP etc.)
- Global monitoring report
- Report from Implementation and Compliance Committee
- GEF report
- SIP report
- Special Programme report

- Other relevant information including the Global Mercury Assessment, UNEP Supply and Trade Report, voluntary submissions, reports from IGOs (WHO, ILO, UNDP, AMAP, UNIDO etc), Minamata Initial Assessments, Global Mercury Partnership, project reports, UN trade data, scientific literature, among others.

➢Stage 2 information synthesis and evaluation

- The Secretariat prepares a preliminary report using the information from stage 1. This preliminary report includes a compilation of the various information and data available to facilitate the evaluation of the Convention.
- The effectiveness evaluation committee will review and assess the information compiled by the Secretariat.
- The Committee draws conclusions as to the effectiveness of the Convention, and make recommendations to the Conference of the Parties on any improvements that might be warranted.

3.d. Schedule for effectiveness evaluation

With a view to the first effectiveness evaluation report being submitted no later than 6 years after the entry into force of the Convention, the expert group developed a draft schedule of effectiveness evaluation (Table 5).

With regard to the interval after the first effectiveness evaluation, the group noted that the 4 year reporting cycle under Article 21, availability of monitoring data, reporting on financial assistance, etc. should be considered. However, the group focused on the schedule of the first evaluation, and did not recommend any specific schedule for the interval after the first evaluation.

Table 5. Proposed schedule for effectiveness evaluation

Year	Available information	Monitoring data	Effectiveness evaluation
2017 Entry into force, COP1			
2018 COP2	• GMA • Most MIAs completed	• COP2 considers result of intersessional work and how to address gaps and organize future monitoring including organizational arrangements	• COP2 considers result of intersessional work and considers how to establish EE framework
2019 COP3	• Article 21 reporting: First biennial short report by 31 Dec	• Approve monitoring arrangements, including timeline for submission of data	• EE framework adopted • EE committee members nominated
2020	• First NAP submission starts • Submission on release source categories		
2021 COP4	• Article 21 reporting: First full report by 31 Dec	• COP4 initiates the first monitoring report, which will feed into effectiveness evaluation	• All Stage 1 reports to be submitted to the Secretariat (except for global monitoring report)
2022	• Article 21 national reports compiled. • Emission/ release inventories start to be submitted	• Prepare monitoring report and submission to EE group to feed into EE report - to address Art 22 para 2 in facilitating the evaluation	• June: stage 1 completed • December: Secretariat to develop preliminary analysis. • Committee meets to review the information.
2023 COP5	• Biennial report • NAP review	• COP5 welcomes monitoring report.	• COP5 welcomes EE report.

3.e. Arrangements for conducting the effectiveness evaluation

The process flow described in 3.e need to be reviewed further to specify who does what for information collection, compilation, synthesis and evaluation

3.f. Terms of reference for the committee developing the first effectiveness evaluation

The Conference of the Parties mandated the group to draft terms of reference for the effectiveness evaluation committee that can be used when COP decides to establish it. Taking into consideration the experience of the Stockholm Convention, the group developed draft terms of reference for an effectiveness evaluation committee as annexed to this report.

Recommendations for the effectiveness evaluation framework.

The ad-hoc expert group developed an initial list of indicators for the first effectiveness evaluation. Further work is needed to review the data limitation and baseline for these indicators, as well as to develop methods to analyse the article-by-article indicators for the overall effectiveness evaluation, and to consider the use of monitoring information in effectiveness evaluation.

The ad-hoc expert group recommend two-stage process and schedule for the first effectiveness evaluation as described in the meeting report. The Conference of the Parties should consider the proposal with a view to establishing an effectiveness evaluation framework at its third meeting.

The terms of reference of an effectiveness evaluation committee, as proposed in the report, should be considered in establishing the effectiveness evaluation framework.

Annex

Draft terms of reference for the effectiveness evaluation committee

A. Mandate

1. An effectiveness evaluation committee (hereinafter, "the committee") is established to perform the functions assigned to it by the Conference of the Parties.

B. Membership

2. The committee members shall be appointed on the basis of equitable geographical distribution, taking into account gender and the need for a balance between types of expertise.

3. The effectiveness evaluation committee shall consist of twelve experts, as follows:

(a) Ten experts designated by parties from the five United Nations regions, and elected by the Conference of the Parties;

(b) One expert representing the monitoring arrangement;

(c) One expert representing the implementation and compliance committee;

4. Experts designated by parties and elected by the Conference of the Parties shall have expertise in policy evaluation, environmental and health monitoring, compliance, reporting and national implementation, or financial or technical assistance.

5. Experts from the monitoring arrangement and the implementation and compliance committee shall be selected by and from among the members of their respective bodies.

6. The terms of office shall coincide with a cycle of evaluation as determined by the Conference of the Parties.

7. If a member is unable to complete his or her term of office, the region nominating that member shall nominate another person to complete the term.

C. Invited experts and observers

8. The Secretariat shall select two internationally recognized experts in effectiveness evaluation with due consideration to available expertise on the measures.

9. The Secretariat shall invite one representative of the World Health Organization as an observer

10. The committee will invite the participation of up to five experts from civil society, indigenous organizations, intergovernmental organizations, industry and the UNEP Global Mercury Partnership as observers. The participation of observers will be balanced among the above-mentioned groups and gender.

11. The committee may allow additional observers within reasonable limits.

D. Officers

12. The committee shall elect, from among its members, a chair and a vice-chair.

E. Administrative and procedural matters

13. The committee shall apply, mutatis mutandis, the rules of procedure of the Conference of the Parties, unless otherwise provided in these terms of reference.

14. The committee may establish such arrangements as are necessary to facilitate its work in line with the present terms of reference.

15. The committee members shall seek to reach agreement by consensus. Should consensus not be reached by members, the range of their views shall be reflected in any report to be submitted to the Conference of the Parties.

F. Workplans

16. The committee shall report to the Conference of the Parties on all elements of the evaluation framework based on national reports submitted, the global monitoring reports, and on other available information, at the date established by Conference of the Parties.

G. Meetings

17. The committee shall hold at least one face-to-face meeting, to review the information available for each evaluation cycle and to develop a report to the Conference of the Parties, subject to the availability of funds and work requirements. Based on the decisions of the Conference of the Parties, the frequency of committee meetings may be amended as necessary.

18. Documents to be transmitted to the Conference of the Parties shall be finalized by the committee at least four months before the meeting of the Conference of the Parties.

H. Language of meetings

19. The working language of the committee shall be English.

I. Reporting to the Conference of the Parties

20. The committee shall report to the Conference of the Parties. Reports of the committee shall reflect any dissenting views.

21. At the end of the first evaluation cycle, the committee shall make recommendations to the Conference of the Parties on future evaluations, including on the arrangements, schedules and experience using the framework for effectiveness evaluation.

22. Decisions, recommendations and meeting reports of the committee shall be made available as meeting documents of the Conference of the Parties. Reports of the committee shall also be made easily accessible and publicly available.

J. Budget

23. Except for members from developed-country parties referred to in paragraph 4 of the present terms of reference, financial support for travel and daily subsistence allowance shall, within available resources, be made available to committee members, invited experts and observers for participation in meetings of the committee according to United Nations practice.